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POLITE ARTS.

No. I.

MACHINE FOR DESCRIBING SPIRAL LINES.

The LARGE SILVER MEDAL and FIFTEEN POUNDS were presented to Mr. T. LANE, of Stockwell, for his Instrument for Describing Spiral Lines, which has been placed in the Society's Repository.

Lark Hall, Stockwell, opposite
China Cottage.

SIR,

I BEG leave to request you to lay before the Society for the Encouragement of Arts, Manufactures, and Commerce, the accompanying instrument of my invention, for drawing spiral lines, or volutes of various forms and dimensions, either right or left-handed, as will be seen by the several specimens I have enclosed with the instrument. I know of no other method of describing a volute perfectly correct but by an instrument of this kind, which describes the volute or spirals in one continued line to any number of revolutions required for general purposes.

Should the Society determine on taking it into their consideration, I shall be happy to attend to explain the method of using it at any time they may appoint.

I am, Sir, &c. &c.

THOMAS LANE.

A. AIKIN, Esq.
Secretary, &c. &c.

It is evident, that if a pen or point were fixed in a revolving frame it would describe a circle, the magnitude of which would depend on the distance of such point from the centre on which the frame turns. If, instead of the point being fixed, it should have a radial motion from the centre given to it during its revolution, the result of these two motions will be a spiral. If the radial motion of the point be regulated by a screw, so contrived that this latter shall make one turn, or any fixed number of turns, while the frame performs one revolution, the distance between any two adjacent turns will be constant; and all spirals described by such an instrument will be equal and similar. By substituting a screw of slower, or of more rapid rake, a spiral, with turns nearer to or more distant from each other, will be produced; but in each spiral the distance between any two adjacent turns will still be the same. No increasing spirals (such as the volute of an Ionic capital) can, therefore, be formed by such an instrument.

In Mr. Lane's machine the pen is actuated both by a circular motion, and by a radial one regulated by a screw; but between the two is interposed a contrivance for making the distance between the turns a regularly increasing one, according to a rate previously determined. This is the circumstance which constitutes the novelty of the machine.

Before proceeding to a detailed description of the parts, it may be useful to call the reader's attention in a general way to those in which Mr. Lane's contrivance essentially consists. In Plate I. figs. 3 and 15, *z* is a sliding bar, carrying the pen, and connected by the cord *g* to the helical spring 7: the action of this spring is to draw the bar in the direction of the arrow, and therefore to give a radial motion, or motion outwards from the centre to the pen. The bar 3 is joined to the sliding bar, and therefore moves parallel to the long side of the revolving frame 1 2; *s* is a fixed, and *t* is an adjustable arm, moving when in use on one axis, and connected by means of the cord 10 with the helical spring 8, the tendency of which is to relieve the pressure of the friction-roller of the arm *t* from the bar 3, and to press the friction-roller of the arm *s* against the bar *p*; this latter is connected with the nut *m*, which traverses on the screw *k*, according as the screw is made to revolve on its axis by means of the handle *l*, which at the same time gives a rotatory motion to the frame 1 2, and to all the parts connected with it. The bar *p*, therefore, (fig. 3) has an equable motion from left to right, traversing equal spaces in each turn of the handle.

In the diagram, fig. 2, the instrument is represented as adjusted for a spiral of eight turns, and the numbers 1, 2, 3, &c. to 8, between *p* and *p*, shew the equal intervals passed over by the bar *p* at each turn of the handle. When, therefore, by the first turn of the handle the bar *p* has passed from its starting place 0 to 1, the spring 8 will have drawn the arm *s* so that its friction-roller (represented by the little circle at the end of the arm) will have described the arc 0 1; the arm *t* will also have described its arc 0 1, and thus will have allowed the helical spring 7 to draw the bar 3 from 0 to 1; at the same time the pen will have formed the first turn of the spiral, cutting the dotted line projecting to the left from the central circle 11 in the point 1. So when *p* has moved from 1 to 2, corresponding movements, as above described, will be made in the arms *s* and *t*, in the bar 3, and in the pen describing the spiral. Now, it is evident on inspection of the diagram, that while the bar *p* is describing equal spaces, the arm *s* is describing increasing spaces. If the arms *s* and *t* were precisely at right angles to each other, the acceleration or ratio of increase of the motion of the arm *t*, the bar 3, and the pen, would be doubled; but the angular distance between *s* and *t* is adjustable within certain limits; and this additional acceleration of the bar 3, and of the opening of the spiral described by the pen, diminish in proportion to the obtuseness of the angle; so that when the arms *s* and *t* are in the same right line, the acceleration of *s* becomes annulled, and a spiral of equal distances is produced.

a b, fig. 4, is a horizontal bar supported by the blocks or feet *cc*, at a suitable height above the drawing-board *dd*, to which it is attached by the long screws at each end *a b*. In the middle of this bar is a vertical socket *ee*, and a fixed wheel *f*; within the pipe or socket *e* is nicely fitted the axis *g* of the bar *hi*, figs. 5, 6, and 7; on this bar are two standards with sharp centres *jj*, to receive the screw *k*; so that its pinion *k* shall engage the teeth of the fixed wheel *f*; therefore, when the bar *hi* is made to revolve, by moving the handle *l*, it carries the screw *k* round with it; and as the pinion *k* engages the teeth of the fixed wheel *f*, the screw is obliged to revolve on its own axis whilst being carried round. On the screw *k* is a screwed nut *m*, which cannot turn with the screw; it therefore traverses to or from the centre according as the handle *l* is turned one way or the other. On the bar *hi* is laid the sliding bar *no*, figs. 8 and 9, from which projects at a right angle the arm *p*; at the end *o* is a hole to receive the pin which projects from the bottom of the nut *m*, connecting the nut and the sliding bar; therefore, when the nut *m* travels, it carries the arm *p* along with it. In fig. 10 the screw *k* and nut *m* are shewn on the bar *no*: this is the only use of the screw and nut. In fig. 14 the parts above mentioned are seen in their natural connexion. Now, if a pen was attached to the nut *m*, or to the sliding bar *n o*, it would draw one equal spiral, but that property is not used here: the screw *k* is made to revolve only for the purpose of moving the arm *p* equally to and fro.

At one side of the bar *h i*, and very near the centre, is a vertical socket *q*, figs. 5, 6, and 17; it receives the short axis *r*, shewn separate in fig. 11; the socket *q* has a gap in it to receive an arm *s*; the upper square on the axis *r* corresponds with this gap, and fits the arm *s*; an opposite arm *t* fits on the round part of the axis *r* at the bottom, and is followed by a quadrant *u*, which is squared on to the axis and secured by a nut *v*; thus the arm *s*, the axis *r*, and quadrant *u*, are fixed together as one, while the arm *t* is free to move: this latter has a binding screw *w*, which passes through the quadrant to fix it at any required angle with the arm *s*. These arms *s* and *t* are shewn so united in fig. 1. Near the ends of the bar *h i* are fixed the pendants *x* and *y*, fig. 6; these have each a square hole cut through their lower end to receive a sliding bar *z*, shewn separate in fig. 12, and in place in figs. 3, 13, 14, and 15; and lastly, to the very ends of the bar *h i* is screwed a parallel frame 1 2, figs. 3, 14, and 15, for the purpose of supporting the arms, and for carrying other parts of the machine. On the sliding bar *z*, fig. 12, is fitted an arm 3, shewn in place figs. 14 and 15, and detached in fig. 16; it has a binding screw 4, to fix it at the required place: also on the bar *z* is fitted the frame 5, (figs. 12 and 14) in which the pen or pencil slides; it is fixed by the screw 6. To the rectangular frame 1 2 are screwed two pendent axes, with spring barrels, 7 and 8, on them; round these barrels are cords 9 and 10. The cord 9 is attached to the pen-frame 5, as shewn in fig. 12;

and the cord 10 is attached to the quadrant, which has a groove for the cord to lie in.

Fig. 17 is a section of the socket *e*, to shew the axis *g* in its place; the bar *z*, and frame 1 2, being represented in section corresponding with the line 12 12, fig. 15.

Fig. 13 is a side elevation, the opposite sides 12 12 of the frame 1 2, fig. 15, only being removed.

Fig. 14 is a perspective view, and fig. 15 a plan; fig. 3 is a part of the machine to shew the means of setting it for any particular spiral. In fig. 13, at one end of the sliding bar *z*, is a small pin 14. In beginning to use the instrument, that end of the bar is pushed in till the pin touches the pendant *x*, this stops it always at the same place; and in figs. 6 and 15, in the pendant *x*, is shewn a screw 13, that is tightened to hold it there, because the action of the spring 7 tends to pull the bar *z* out at that end, when so bound: the pen may be placed at any distance from the centre to draw a circle. On one side of fig. 13 is a separate view of the spring-barrel 8, to shew a screw-nut under it, by which it may be bound fast so as not to act on the arms when a circle is being drawn, as that spring always tends to pull the arm *s* towards itself. On the arms *s* and *t*, figs. 3 and 17, are shewn slides carrying friction-rollers; on the arm *s* the roller is above, and on the arm *t* it is below. These rollers being the acting parts on the arms *s* and *t*, the diameter and number of coils formed by the pen are determined by their adjustment.

Having described nearly all the parts, I will proceed to shew how the instrument is to be set for any particular spiral, first observing that the spring 7 strives to draw the pen that way from the centre (see fig. 3), but is prevented from so doing by the roller on the arm *t* stopping the arm 3, (which arm moves with the pen); next, the spring 8 pulling the quadrant *u*, strives to draw the arm *s*, fig. 15, towards itself; this would remove the roller on *t* out of the way of the arm 3, and thus liberate the pen; therefore, another arm *p* is opposed to the roller on *s*, and stops that arm. Now the arm *p* can only be removed, and that progressively, in equal quantities at each turn, by the revolving of the screw *k* (shewn in place in figs. 13, 14, and 15); and this screw can only be made to revolve by turning the whole machine round by the handle *l*, which carries the screw-pinion round under the fixed wheel *f*. Thus, by the gradual or successive liberation of the four arms *p*, *s*, *t*, and 3, fig. 3, the spring 7 is enabled to pull the pen farther and farther from the centre at each turn; therefore, while the pen is being carried round, it opens into a spiral course instead of describing circles. To set the machine for drawing the largest spiral, the small roller is slid to the very end of the arm *t*; for any smaller one it is slid so much nearer to the centre: now, if the roller on *t* is fixed at any place, and allowed to move 90°, the diameter of the spirals will be the same whether the coils are made one or many, the number of coils being determined by the roller on *s*. If the roller is placed at the extremity of the arm *s*, it will require the nut *m*, fig. 6, to travel the whole length of the screw *k* to let the arm *s* move 90°, and this takes above eight turns of the instrument; therefore it will give eight coils. If the roller is placed at the middle of *s*, four turns will allow the arms *s* and *t* to move 90°, giving four coils; if placed at one quarter from the centre on the arm *s*, two turns will allow the full motion of 90°, and there will be but two coils; or, still nearer, one turn may give one coil of the full extent. If the screw *k* had twice as many threads it would give twice as many coils, a coarser screw fewer coils. Two screws *k* are provided of the same rake, only one is right and the other left, so that whatever spiral is drawn to the right, by changing the screw exactly the same may be drawn to the left. The diagram, fig. 2, shews the progressive receding of the arm *p* through eight turns, the spring 8 keeping the roller on *s*, following in close contact: this moves the arm *t* with its roller in the same angular acceleration; but as it begins to move nearly parallel with the arm 3, and leaves off when moving at right angles to it, there is a second acceleration in the arm 3, it being kept following in close contact with the roller on *t* by the spring 7. Thus the bar *z* keeps sliding with increasing speed through every turn, and brings the pen successively through the marks 1, 2, 3, to 8, on the dotted line to the left of the central circle 11. I have described the action as though the arms *s* and *t* were correctly at right angles to each other; this position of them would be proper if the spiral began from a point, but, as a small circle is generally placed within the spiral, in that case, if the arm *t* began to move from the first degree, the first coil would not open sufficiently quick to be of an agreeable or just proportion to that circle; but by letting the arm *t* advance a few degrees, the artist may choose at what rate the first coil shall begin: for this purpose, an arc of 60° is attached to the frame, as shewn in figs. 3, 14, and 15.

It must be here observed, that when the arms *s* and *t* are at right angles, they give the most rapidly increasing spiral; but if they are opened to a right line, as shewn by dots in fig. 1, they give an equal or parallel spiral, every coil being equidistant; therefore, by opening the angle above 90°, any desired variation of the coils may be obtained. Agreeably with this, Mr. Lane has given the angles at which, on his instrument in the Society's repository, the arms *s* and *t* must be put, to imitate the spirals which were used in four different Greek temples. First, let the arm *p* be slid towards the centre till it brings the arm *s* parallel to it, as in fig. 3; then place the centre of the arm *t* opposite 20½ on the arc—this makes an angle between the two arms of 110° 30′; then place the roller on *s* at such a distance as to give 2¾ turns; by the time the arm *t* arrives at its dotted place *t*, &c. it will describe the spiral shewn in fig. 3, which imitates one from a temple on the Ilissus at Athens. If the arms *s t* are opened 109° 15′ it will imitate the spiral of the temple of Minerva Polias at Priene, 114° 30′ serves for the temple of Minerva Polias at Athens, and 115° serves for the temple of Erectheus at Athens; provided in each case the roller on *s* is adjusted to give the right number of turns. If a coarser screw *k* was used, the same spiral could be produced, provided there was room on the arm *s* to remove the roller as much farther out as the screw was coarser, and *vice versâ*. Thus the adjustment on the arm *s* is within certain limits a compensation for screws differing in their threads.

Whilst setting the instrument, the sliding bar *z* is always pushed to the right of fig. 3 as far as it will go, and then held there by the screw 13, fig. 6, and when the arms and rollers *s t* are put right, the arm 3 is to be slid along the bar *z* till it touches the roller *t*, and is then to be bound fast; the pen is also put either at the centre or at the proper distance from it to begin; then, if the instrument is turned without loosening the bar *z*, the pen will describe a circle; but this turning will have removed the arm *p* from the roller *s*, if the spring 8 has also been fastened by its under screw; therefore the machine must be turned back to bring them in contact again: lastly, liberate the spring 8, and the sliding bar *z*, and the spiral may be drawn by turning the instrument round.

When describing an equal spiral, by having fixed the arms *s t* directly opposite to each other, the same rule holds, that the roller *t* determines the size, and the roller *s* the number of coils in that size, and, whether few or many, they will every where be equidistant.

Some of the figures are dissections into separate masses, to shew the parts that move together. Thus, fig. 10 shews the screw *k* by which the arm *p* is moved—this is the first mass that is put in motion by turning the machine; then fig. 1 shews the two arms that are moved by the spring 8, which pulls the roller *s* after the arm *p* — this is the second mass, following close after the first; and fig. 12 shews the pen, the sliding bar *z*, and the arm 3, as one mass, being pulled by the spring 7, which makes the arm 3 follow close after the roller *t*. Thus there are three moving masses, figs. 10, 1, and 12; the first has motion given to it by turning the machine, the two others follow in close succession. At fig. 18, 5 5 is a front and side view of the pen slide; 15, 16, and 17, are top, side, and front views of the grooved slide; 18 the pen—it is held in the slide by a screw 19; 20 is a projecting part of the slide that hangs on the eccentric or crank-shaped axis 21, so that by turning one side upwards, the pen is raised off the paper, and by turning the other up it is dropped or left to slide down on the paper.